ATTACHMENT B

BLANEY-CRIDDLE METHODOLOGY AND REUSE FACTORS

ATTACHMENT B
BLANEY-CRIDDLE EXPANATION

The basic B-C formula states that the consumptive use (U) is equal to a seasonal consumptive use factor coefficient (k), times a monthly consumptive use factor (f), therefore U=k*f. F is a function of the mean monthly temperature in degrees Fahrenheit (t) times the monthly percent of daytime hours (p), divided by 100, expressed as f=t*p/100. K is a factor relating the plant water usage for a specific species. K factors are generated under experimental conditions where F and U are measured under tightly controlled conditions. This analysis uses a modified B-C method beginning with a modified (k) factor, explained in Appendix B.

Here, the coefficient (k) is equal to a climatic coefficient, which is related to the mean air temperature (kt), times a coefficient reflecting the growth stage of the crop (kc), (k=kt x kc). In order to approximate evapotranspiration, the following calculations must first be completed:

$f(m) = (t(m) \times p(m))/100,$
$kt(m) = (0.0173 \times t(m)) - 0.314,$
$kt\ f\ (m) = f(m) \times kt(m),$
$U(m) = kt\ f\ (m) \times kc\ (m),$ where,

m = month of year
f(m) = monthly evapotranspiration factor
r(m) = average monthly temperature, (provided)
p(m) = monthly percentage of annual daylight hours, (provided)
kt(m) = kt
U(m) = monthly evapotranspiration
kc(m) = monthly crop coefficient, (provided)

The effective rainfall for crop evapotranspiration is calculated as a function of the 1-in-10 year drought rainfall as:

$Rt(1) = (0.70917 \times (Rt(m)^{(0.82416)}) - 0.11556,$
$U1(m) = 10^{(0.01226 \times U(m))}$
$F1 = 0.531747 + (0.295154 \times D) - (0.057697 \times D^2) + (0.003804 \times D^3)$
$Re(m) = Rt1(m) \times U1(m) \times F1,$ where

Rt1(m) = monthly effective rainfall factor considering 1-in-10 monthly rainfall
Rt(m) = 1-in-10 monthly rainfall, (provided)
U1(m) = monthly effective rainfall factor considering monthly evapotranspiration
F1 = soil factor
D = net depth of application
Re(m) = monthly effective rainfall

After the monthly evapotranspiration, U(m), and the monthly 1-in-10 effective rainfall, Re(m), have been determined, the monthly supplemental crop requirement, Sup(m), is calculated as:

Sup(m) = U(m) – Re (m) for each month of the year

Finally, the irrigation quantity needed to supply the supplemental crop requirement Sup(m) is determined by:

Q(m) = Sup(m) x Ka x A, where

Ka = allocation coefficient multiplier for the irrigation system specified
A = irrigated acreage for the crop

Demand Analysis - Future Collier County North

FY 2000 Actual Reclaimed Water Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
7.7	8.0	8.5	7.2	6.0	5.5	5.8	5.7	5.3	6.7	6.9	7.4	**6.7**	**2,454.6**

Usage Factors (applied to the annual average of Blaney-Criddle demand)											
1.14	1.19	1.26	1.07	0.89	0.82	0.86	0.85	0.79	1.00	1.03	1.10

Modified Blaney Criddle Model Annual Average Irrigation Demand (MGD)	**63.3**

Alternative Method Irrigation Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
72.4	75.3	80.0	67.7	56.4	51.7	54.6	53.6	49.9	63.0	64.9	69.6	**63.3**	**23,091.2**

Demand Analysis - Future Collier County South

FY 2000 Actual Reclaimed Water Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
3.2	5.3	5.3	5.6	4.0	3.8	3.1	2.3	1.3	2.9	3.3	2.1	**3.5**	**1,283.9**

Usage Factors* (applied to the annual average of Blaney-Criddle demand)											
1.14	1.19	1.26	1.07	0.89	0.82	0.86	0.85	0.79	1.00	1.03	1.10

Modified Blaney Criddle Model Irrigation Demand (MGD)	**61.0**

Alternative Method Irrigation Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
69.8	72.6	77.1	65.3	54.4	49.9	52.6	51.7	48.1	60.8	62.6	67.1	**61.0**	**22,261.9**

*Factors were taken from the Collier County North service area in order to display a more realistic distribution

Demand Analysis - Future Golden Gate

FY 00-01 Actual Reclaimed Water Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
0.9	0.8	0.8	0.8	0.8	0.8	1.0	0.9	1.5	0.9	0.8	0.9	**0.9**	**331.1**

Usage Factors (applied to the annual average of Blaney-Criddle demand)											
0.97	0.92	0.89	0.93	0.89	0.86	1.08	0.97	1.64	0.95	0.92	0.97

Modified Blaney Criddle Model Irrigation Demand (MGD)	**7.0**

Alternative Method Irrigation Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
6.8	6.4	6.2	6.5	6.3	6.0	7.6	6.8	11.5	6.6	6.4	6.8	**7.0**	**2,551.9**

Demand Analysis - Future Marco Island

FY 00-01 Actual Reclaimed Water Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
1.2	1.5	1.5	1.8	1.5	1.2	0.4	0.7	0.3	1.1	1.5	1.3	**1.2**	**426.2**

Usage Factors* (applied to the annual average of Blaney-Criddle demand)											
1.14	1.19	1.26	1.07	0.89	0.82	0.86	0.85	0.79	1.00	1.03	1.10

Modified Blaney Criddle Model Irrigation Demand (MGD)	**7.1**

Alternative Method Irrigation Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
8.2	8.5	9.0	7.6	6.4	5.8	6.2	6.1	5.6	7.1	7.3	7.9	**7.1**	**2,607.7**

*Factors were taken from the Collier County North service area in order to display a more realistic distribution

Demand Analysis - Future Naples

FY 00-01 Actual Reclaimed Water Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
6.2	6.2	6.1	6.1	6.0	6.0	6.1	6.1	6.1	6.2	6.1	6.1	**6.1**	**2,227.7**

Usage Factors* (applied to the annual average of Blaney-Criddle demand)											
1.14	1.19	1.26	1.07	0.89	0.82	0.86	0.85	0.79	1.00	1.03	1.10

Modified Blaney Criddle Model Irrigation Demand (MGD)	**15.1**

Alternative Method Irrigation Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
17.3	18.0	19.1	16.2	13.5	12.3	13.0	12.8	11.9	15.0	15.5	16.6	**15.1**	**5,509.9**

*Factors were taken from the Collier County North service area in order to display a more realistic distribution

Demand Analysis - Future Bonita Springs

FY 2001 Actual Reclaimed Water Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
2.9	2.9	3.1	2.8	2.3	2.1	2.0	2.4	2.6	2.8	2.9	3.0	**2.6**	**966.6**

Usage Factors (applied to average of Blaney-Criddle demand)											
1.08	1.09	1.17	1.07	0.86	0.81	0.75	0.92	0.96	1.07	1.08	1.12

Modified Blaney-Criddle Model Annual Average Irrigation Demand (MGD)	**21.5**

Alternative Method Irrigation Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
23.2	23.5	25.2	23.0	18.6	17.4	16.1	19.8	20.7	23.1	23.2	24.2	**21.5**	**7,846.9**

*Demands provided by Resource Conservation Services

Demand Analysis - Future Cape Coral

FY 2000 Actual Reclaimed Water Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
20.5	24.1	26.5	32.4	32.5	15.9	12.9	11.3	9.3	22.8	30.3	21.7	**21.7**	**7,909.6**

Usage Factors (applied to average of Blaney-Criddle demand)											
0.94	1.11	1.22	1.49	1.50	0.73	0.60	0.52	0.43	1.05	1.40	1.00

Modified Blaney-Criddle Model Annual Average Irrigation Demand (MGD)	**56.1**

Alternative Method Irrigation Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
53.0	62.4	68.4	83.7	84.1	41.1	33.4	29.3	24.0	58.9	78.3	56.1	**56.1**	**20,463.1**

Demand Analysis - Future Fiesta Village

FY 2000 Actual Reclaimed Water Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
1.0	1.3	1.1	1.2	1.2	0.6	0.4	0.4	0.2	0.9	1.3	1.0	**0.9**	**321.5**

Usage Factors* (applied to average of Blaney-Criddle demand)											
1.16	1.43	1.29	1.31	1.31	0.73	0.45	0.41	0.71	1.02	1.51	1.18

Modified Blaney-Criddle Model Annual Average Irrigation Demand (MGD)	6.2

Alternative Method Irrigation Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
7.1	8.8	8.0	8.1	8.1	4.5	2.8	2.5	4.4	6.3	9.3	7.3	**6.4**	**2,346.6**

* The factor for the month of September was modified in order to display a more realistic distribution

Demand Analysis - Future Forest Utility

FY 00-01 Actual Reclaimed Water Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.3	**0.2**	**90.9**

Usage Factors (applied to average of Blaney-Criddle demand)											
1.16	1.12	1.08	1.03	0.95	0.94	0.96	0.83	0.86	1.01	1.00	1.08

Modified Blaney-Criddle Model Annual Average Irrigation Demand (MGD)	**0.9**

Alternative Method Irrigation Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
1.0	1.0	1.0	0.9	0.8	0.8	0.8	0.7	0.8	0.9	0.9	1.0	**0.9**	**322.9**

Demand Analysis - Future Ft. Myers Beach

FY 2000 Actual Reclaimed Water Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
2.1	1.9	3.6	3.6	2.8	2.1	2.0	2.0	1.2	2.6	2.8	2.1	**2.4**	**874.8**

Usage Factors* (applied to average of Blaney-Criddle demand)											
0.87	0.77	1.50	1.51	1.18	0.87	0.85	0.84	0.96	1.08	1.19	0.86

Modified Blaney-Criddle Model Annual Average Irrigation Demand (MGD)	**18.8**

Alternative Method Irrigation Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
16.3	14.5	28.2	28.3	22.2	16.3	15.9	15.7	18.1	20.4	22.3	16.1	**19.5**	**7,127.3**

*The factor for the month of September was modified in order to display a more realistic distribution

Demand Analysis - Future Ft. Myers Central

FY 00-01 Actual Reclaimed Water Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
0.6	0.7	0.8	0.8	0.8	0.7	0.7	0.7	0.6	0.7	0.7	0.6	**0.7**	**250.6**

Usage Factors (applied to average of Blaney-Criddle demand)											
0.93	0.96	1.09	1.17	1.14	0.98	0.99	0.98	0.92	0.99	0.95	0.92

Modified Blaney-Criddle Model Annual Average Irrigation Demand (MGD)	**11.6**

Alternative Method Irrigation Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
10.8	11.2	12.7	13.5	13.2	11.3	11.5	11.3	10.6	11.5	11.0	10.6	**11.6**	**4,235.3**

Demand Analysis - Future Ft. Myers South

FY 00-01 Actual Reclaimed Water Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**0.0**	**0.0**

Usage Factors (applied to average of Blaney-Criddle demand)											
0	0	0	0	0	0	0	0	0	0	0	0

Modified Blaney-Criddle Model Annual Average Irrigation Demand (MGD)	**0.0**

Alternative Method Irrigation Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**

Demand Analysis - Future Gateway

FY 2000 Actual Reclaimed Water Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	**0.3**	**107.2**

Usage Factors (applied to average of Blaney-Criddle demand)											
0.95	0.91	0.96	0.89	0.93	0.96	0.94	1.12	1.09	1.09	1.11	1.05

Modified Blaney-Criddle Model Annual Average Irrigation Demand (MGD)	**4.5**

Alternative Method Irrigation Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
4.2	4.0	4.3	4.0	4.2	4.3	4.2	5.0	4.9	4.9	5.0	4.7	**4.5**	**1,631.8**

Demand Analysis - Future Gulf Environmental Services

FY 00-01 Actual Reclaimed Water Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	**0.8**	**276.2**

Usage Factors* (applied to average of Blaney-Criddle demand)											
1.08	1.09	1.17	1.07	0.86	0.81	0.75	0.92	0.96	1.07	1.08	1.12

Modified Blaney-Criddle Model Annual Average Irrigation Demand (MGD)	11.5

Alternative Method Irrigation Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
12.4	12.6	13.5	12.3	10.0	9.3	8.6	10.6	11.1	12.4	12.4	13.0	**11.5**	**4,202.7**

*Factors were taken from Bonita Springs service area to display a more realistic distribution

Demand Analysis - Future Lehigh Acres

FY 00-01 Actual Reclaimed Water Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
0.9	0.8	0.8	0.8	0.6	0.8	1.1	1.7	2.4	2.0	1.2	1.2	**1.2**	**438.4**

Usage Factors* (applied to average of Blaney-Criddle demand)											
0.87	0.77	1.50	1.51	1.18	0.87	0.85	0.84	0.96	1.08	1.19	0.86

Modified Blaney-Criddle Model Annual Average Irrigation Demand (MGD)	**31.9**

Alternative Method Irrigation Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
27.8	24.7	47.9	48.1	37.8	27.8	27.1	26.8	30.7	34.6	38.0	27.4	**33.2**	**12,128.1**

*Factors were taken from Ft. Myers Beach service area to display a more realistic distribution

Demand Analysis - Future North Ft. Myers

FY 00-01 Actual Reclaimed Water Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
0.8	0.8	0.6	1.1	0.9	0.7	0.6	0.3	0.5	0.8	0.8	0.8	**0.7**	**262.5**

Usage Factors (applied to average of Blaney-Criddle demand)											
1.10	1.08	0.87	1.48	1.23	1.00	0.82	0.46	0.65	1.07	1.10	1.13

Modified Blaney-Criddle Model Annual Average Irrigation Demand (MGD)	**17.6**

Alternative Method Irrigation Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
19.4	19.0	15.4	26.1	21.8	17.7	14.5	8.2	11.4	18.9	19.3	20.0	**17.6**	**6,435.6**

Demand Analysis - Future Pine Island

FY 2001 Actual Reclaimed Water Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	**0.1**	**36.5**

Usage Factors (applied to average of Blaney-Criddle demand)											
1	1	1	1	1	1	1	1	1	1	1	1

Modified Blaney-Criddle Model Annual Average Irrigation Demand (MGD)	**5.4**

Alternative Method Irrigation Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	**5.4**	**1,982.0**

Demand Analysis - Future Sanibel

FY 1999 Actual Reclaimed Water Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
0.8	0.9	1.0	0.9	0.7	0.8	1.0	0.8	0.8	0.7	1.0	0.7	**0.8**	**304.8**

Usage Factors (applied to average of Blaney-Criddle demand)											
0.98	1.05	1.19	1.10	0.79	0.91	1.22	0.96	0.91	0.85	1.19	0.84

Modified Blaney-Criddle Model Annual Average Irrigation Demand (MGD)	**3.5**

Alternative Method Irrigation Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
3.4	3.7	4.1	3.8	2.7	3.2	4.2	3.3	3.2	3.0	4.1	2.9	**3.5**	**1,267.1**

Demand Analysis - Future Waterway Estates

FY 2000 Actual Reclaimed Water Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
0.03	0.15	0.03	0.03	0.03	0.04	0.00	0.00	0.00	0.00	0.00	0.00	**0.0**	**9.2**

Usage Factors (applied to average of Blaney-Criddle demand)											
0.99	5.82	1.27	1.15	1.15	1.50	0.12	0.00	0.00	0.00	0.00	0.00

Modified Blaney-Criddle Model Annual Average Irrigation Demand (MGD)	**2.8**

Alternative Method Irrigation Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
2.7	16.1	3.5	3.2	3.2	4.2	0.3	0.0	0.0	0.0	0.0	0.0	**2.8**	**1,010.9**

Demand Analysis - Future Waterway Estates

FY 2000 Actual Reclaimed Water Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
0.03	0.15	0.03	0.03	0.03	0.04	0.00	0.00	0.00	0.00	0.00	0.00	**0.0**	**9.2**

Usage Factors (applied to average of Blaney-Criddle demand)											
0.99	5.82	1.27	1.15	1.15	1.50	0.12	0.00	0.00	0.00	0.00	0.00

Modified Blaney-Criddle Model Annual Average Irrigation Demand (MGD)	**2.8**

Alternative Method Irrigation Demand (MGD)												Annual Average	Annual Total
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	(MGD)	(MGY)
2.7	16.1	3.5	3.2	3.2	4.2	0.3	0.0	0.0	0.0	0.0	0.0	**2.8**	**1,010.9**